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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/628,020	07/25/2003	Yee-Chia Yeo	TSM03-0555	3380
43859	7590	12/09/2004	EXAMINER	
SLATER & MATSIL, L.L.P. 17950 PRESTON ROAD, SUITE 1000 DALLAS, TX 75252			HUYNH, ANDY	
			ART UNIT	PAPER NUMBER
			2818	

DATE MAILED: 12/09/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. ✓ 10/628,020	Applicant(s) YEO ET AL.	
	Examiner Andy .Huynh	Art Unit 2818	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 November 2004.
 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-93 is/are pending in the application.
 4a) Of the above claim(s) 58-93 is/are withdrawn from consideration.
 5) ☐ Claim(s) _____ is/are allowed.
 6) ☒ Claim(s) 1-42 and 47-57 is/are rejected.
 7) ☒ Claim(s) 43-46 is/are objected to.
 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
 10) ☒ The drawing(s) filed on 25 July 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
 * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>11/3/03; 6/1, 14/04</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

In the Response to the Restriction Requirement dated November 5, 2004, Applicant has elected Group I, claims 1-57, drawn to a device is acknowledged. Because Applicant did not distinctly and specifically point out the supposed error in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)). Accordingly, claims 58-93 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 35 § 1.142(b) and MPEP § 821.03. Applicant has the right to file a divisional application covering the subject matter of the non-elected claims 58-93, drawn to a method.

Information Disclosure Statement

This office acknowledges receipt of the following items from the applicant: Information Disclosure Statement (IDS) filed on 11/03/2003, 06/01/2004 and 06/14/2004. The references cited on the PTOL 1449 form have been considered.

Specification

The disclosure is objected to because of the following informalities:

The disclosure is objected to because of the following informalities: The CROSS-REFERENCE TO RELATED APPLICATIONS on page 1 should be updated.

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Claim Objections

Claims **52, 53 and 57** are objected to because of the following informalities:

Regarding claims **52-53**, the inter-layer dielectric comprises a dielectric with a relative permittivity less than about 3.0 or 3.5 are not disclosed or described in the specification.

Appropriate correction is required.

Regarding claim **57**, “the capacitor wherein semiconductor substrate comprises a semiconductor on insulator substrate including a plurality of islands, wherein the islands are isolated from one another by mesa isolation” is not disclosed or described in the drawings.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims **21-22 and 57** are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims **21 and 22** recite the limitation “the bottom electrode contact region.” There is insufficient antecedent basis for this limitation in the claim **1**.

Claim **57** recites the limitation “... wherein semiconductor substrate comprises a semiconductor on insulator substrate ...” is vague and confusing. What is a semiconductor?

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims **1-42 and 47-56** are rejected under 35 U.S.C. 103(a) as being unpatentable over Belleville et al. (USP 6,558,998 hereinafter referred to as "Belleville"), Applicant submitted prior art (ASPA), in view of Yang et al (USP 6,518,610 hereinafter referred to as "Yang").

Regarding claims **1, 11 and 12**, Belleville discloses in Figs. 2-8 and the corresponding texts as set forth in column 2, lines 1-67, column 4, line 55-column 6, line 60, a capacitor comprises:

- an insulating layer (col. 2, lines 28-45) overlying a substrate (102);
- a semiconductor/conductive layer (110) overlying the insulator layer;
- a bottom electrode (110) formed in a portion of the semiconductor/conductive layer;
- a capacitor dielectric (112) overlying the bottom electrode; and
- a top electrode (114) overlying the capacitor dielectric.

Belleville fails to teach the capacitor dielectric material comprises a high permittivity dielectric comprising hafnium oxide and a material selected from the group consisting of aluminum oxide, hafnium oxynitride, hafnium silicate, zirconium oxide, zirconium oxynitride, zirconium silicate, or combinations thereof and having a dielectric constant greater than about 5.

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Yang teaches that the capacitor dielectric comprises a dielectric material comprising a high permittivity dielectric comprising hafnium oxide and a material selected from the group consisting of aluminum oxide, hafnium oxynitride, hafnium silicate, zirconium oxide, zirconium oxynitride, zirconium silicate, or combinations thereof and having a dielectric constant greater than about 5 as set forth in column 2, lines 16-17, and column 4, lines 12-21.

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to form the capacitor dielectric comprises a dielectric material comprising a high permittivity dielectric comprising hafnium oxide and a material selected from the group consisting of aluminum oxide, hafnium oxynitride, hafnium silicate, zirconium oxide, zirconium oxynitride, zirconium silicate, or combinations thereof and having a dielectric constant greater than about 5, as taught by Yang in order to get more capacitance out of a small area (Yang, col. 1, lines 46-47).

Regarding claim 2, Belleville discloses that the capacitor is a decoupling capacitor (col. 2, lines 50-52).

Regarding claims 3-4, Belleville discloses in Fig. 8 the capacitor wherein the top electrode is connected to a power supply line and the bottom electrode is connected to a ground line; and wherein the top electrode is connected to a first power supply line and the bottom electrode is connected to a second power supply line (col. 6, lines 38-46).

Regarding claim 5, Belleville discloses in Fig. 8 the capacitor wherein the bottom electrode or the top electrode is substantially flat.

Regarding claim 6, Belleville discloses that the capacitor wherein the top electrode comprises poly-crystalline silicon (col. 4, lines 66-67).

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Regarding claims **7-10 and 29-31**, Belleville and Yang disclose the claimed limitations except for the capacitor wherein the top electrode comprises a metal selected from the group consisting of molybdenum, tungsten, titanium, tantalum, platinum, and hafnium; wherein the top electrode comprises a metal nitride selected from the group consisting of molybdenum nitride, tungsten nitride, titanium nitride, tantalum nitride, or combinations thereof; wherein the top electrode comprises a metal silicide selected from the group consisting of nickel silicide, cobalt silicide, tungsten silicide, titanium silicide, tantalum silicide, platinum silicide, erbium silicide, or combinations thereof; and wherein the top electrode comprises a metal oxide selected from the group consisting of ruthenium oxide, indium tin oxide, or combinations thereof. It would have been obvious to one having ordinary skill in the art at the time of the invention was made to form the capacitor wherein the top electrode comprises a metal selected from the group consisting of molybdenum, tungsten, titanium, tantalum, platinum, and hafnium; wherein the top electrode comprises a metal nitride selected from the group consisting of molybdenum nitride, tungsten nitride, titanium nitride, tantalum nitride, or combinations thereof; wherein the top electrode comprises a metal silicide selected from the group consisting of nickel silicide, cobalt silicide, tungsten silicide, titanium silicide, tantalum silicide, platinum silicide, erbium silicide, or combinations thereof; and wherein the top electrode comprises a metal oxide selected from the group consisting of ruthenium oxide, indium tin oxide, or combinations thereof, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

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Regarding claims **13-20, 34-42**, Belleville and Yang disclose the claimed limitations except for the capacitor wherein the high permittivity dielectric has a relative permittivity of greater than about 10 or 20; wherein the capacitor dielectric has a physical thickness of less than about 100 or 20 angstroms; wherein the capacitor has a width of larger than about 5 or 10 microns; wherein the capacitor has a length of larger than about 1 micron or 5 microns. It would have been obvious to one having ordinary skill in the art at the time of the invention was made to form the capacitor wherein the high permittivity dielectric has a relative permittivity of greater than about 10 or 20; wherein the capacitor dielectric has a physical thickness of less than about 100 or 50 or 20 or 10 angstroms; wherein the capacitor has a width of larger than about 5 or 10 microns; wherein the capacitor has a length of larger than about 1 micron or 5 microns, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding claims **23, 24, 26-28, 32 and 33**, Belleville discloses in Figs. 2-8 and the corresponding texts as set forth in column 2, lines 1-67, column 4, line 55-column 6, line 60, a decoupling capacitor comprises:

- a semiconductor substrate (102) comprising a silicon surface layer (110);
- a substantially flat bottom electrode (110) formed in a portion of the semiconductor surface layer;
- a capacitor dielectric (112) overlying the bottom electrode;
- a substantially flat top electrode (114) overlying the capacitor dielectric; and

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wherein the top electrode is electrically coupled to a first reference voltage line/a power supply track (420) and the bottom electrode is electrically coupled to a second reference voltage line/a common ground track.

Belleville fails to teach the capacitor dielectric material comprises a high permittivity dielectric comprising hafnium oxide and a material selected from the group consisting of aluminum oxide, hafnium oxynitride, hafnium silicate, zirconium oxide, zirconium oxynitride, zirconium silicate, or combinations thereof and having a dielectric constant greater than about 5.

Yang teaches that the capacitor dielectric comprises a dielectric material comprises a high permittivity dielectric comprising hafnium oxide and a material selected from the group consisting of aluminum oxide, hafnium oxynitride, hafnium silicate, zirconium oxide, zirconium oxynitride, zirconium silicate, or combinations thereof and having a dielectric constant greater than about 5 as set forth in column 2, lines 16-17, and column 4, lines 12-21.

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to form the capacitor dielectric comprises a dielectric material comprises a high permittivity dielectric comprising hafnium oxide and a material selected from the group consisting of aluminum oxide, hafnium oxynitride, hafnium silicate, zirconium oxide, zirconium oxynitride, zirconium silicate, or combinations thereof and having a dielectric constant greater than about 5, as taught by Yang in order to get more capacitance out of a small area (Yang, col. 1, lines 46-47).

Regarding claim 25, Belleville discloses in Fig. 8 the capacitor wherein the top electrode is connected to a first power supply line (420) and the bottom electrode is connected to a second power supply line (418).

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Regarding claim 47, Belleville and Yang disclose the claimed limitations except for the capacitor further comprising spacers formed on sides of the top electrode. It would have been an obvious matter of design choice to include spacers formed on sides of the top electrode, since applicant has disclosed that spacers are optional as set forth in [0034], and that does not solve any stated problem or is for any particular purpose and it appears that the invention would perform equally well with spacers or without spacers.

Regarding claims 48-49, Belleville and Yang disclose the claimed limitations except for the capacitor further comprises an etch-stop layer comprising silicon nitride overlying the top electrode and the spacers. It would have been obvious to one of ordinary skill in the art at the time of the invention was made to form an etch-stop layer comprising silicon nitride overlying the top electrode and the spacers since it was known in the art that the etch-stop layer is used for protection during a selectively etching process.

Regarding claims 50-51, Belleville discloses in Fig. 8 the capacitor further comprises an inter-layer dielectric/an oxide layer (320).

Regarding claims 52-54, Belleville and Yang disclose the claimed limitations except for the capacitor wherein the inter-layer dielectric comprises a dielectric with a relative permittivity less than about 3.5 or 3.0; and wherein the inter-layer dielectric is selected from the group consisting of benzocyclobutene (BCB), SILK, FLARE, methyl silsesquioxane (MSQ), hydrogen silsesquioxane (HSQ), and SiOF. It would have been obvious to one having ordinary skill in the art at the time of the invention was made to form the inter-layer dielectric comprises a dielectric with a relative permittivity less than about 3.5 or 3.0, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch,

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617 F.2d 272, 205 USPQ 215 (CCPA 1980). It would have been obvious to one having ordinary skill in the art at the time of the invention was made to form the inter-layer dielectric selected from the group consisting of benzocyclobutene (BCB), SILK, FLARE, methyl silsesquioxane (MSQ), hydrogen silsesquioxane (HSQ), and SiOF, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

Regarding claim 55, Belleville discloses in Fig. 8 the capacitor further comprises a first contact plug (418) in electrical contact with the bottom electrode (110) and a second contact plug (420) in electrical contact with the top electrode (114).

Regarding claim 56, Belleville and Yang disclose the claimed limitations except for the capacitor further comprises a shallow trench isolation region adjacent to the bottom electrode. It would have been obvious to one of ordinary skill in the art at the time of the invention was made to form a shallow trench isolation region adjacent to the bottom electrode since it was known in the art that the shallow trench isolation region adjacent to the bottom electrode is used for device isolation.

Allowable Subject Matter

Claims 43-46 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims, since the prior made of record and considered pertinent to the applicant's disclosure does not teach or suggest the claimed limitations. Belleville and Yang, taken alone or in combination, fail to teach the claimed limitation the capacitor wherein the

bottom electrode is doped to a first conductivity type, the capacitor further comprising adjacent doped regions doped to a second conductivity type as recited in claim 43; and the capacitor wherein the bottom electrode is doped to a first conductivity type, the capacitor further comprising adjacent doped regions with the first conductivity type as recited in claim 46.

Conclusion

A shortened statutory period for response to this action is set to expire 3 (three) months and 0 (zero) day from the day of this letter. Failure to respond within the period for response will cause the application to become abandoned (see M.P.E.P 710.02(b)).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andy Huynh, (571) 272-1781. The examiner can normally be reached on Monday-Friday from 8:30 AM to 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms can be reached on (571) 272-1787. The Fax number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose phone number is (703) 308-0956.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR

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system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Ah

Andy Huynh

12/04/04

Patent Examiner